

Nutrition for Performance

INTRODUCTION

Nutrition is a critical factor that influences soldier physical performance. Basic knowledge on how nutrition impacts performance will allow soldiers to obtain the greatest results from their physical readiness efforts. Many of the military tasks soldiers must perform require a level of physical exertion similar to that of trained athletes. As such, soldiers must train and eat like athletes. Athletes and their coaches know that to maximize performance, it is not enough to train well; it is just as important to apply the principles of sound nutrition. Consistently eating the right foods at the right time is as important to an effective PRT Program as the training itself. An effective diet will enhance soldier PRT by supplying and replenishing the fuel needed to get the most from the training. Nutrients must be supplied in proportion to the body's needs to bring about the desired physiologically changes. An ineffective diet in an average soldier may cause fatigue, a lack of resolve, the inability to concentrate, impaired strength, unwanted weight loss or gain, and a susceptibility to illness. The ultimate nutrition goal as it relates to physical readiness should be to optimize physical performance. However, the immediate solution for most soldiers is not a highly specialized diet to maximize performance, but a well balanced diet that will form nutritional patterns for lifelong health. [Eating for performance goals is not at odds with health and weight management goals and soldiers should strive for a balance of all three.] On the PRT field, nutrition can mean the difference between achieving performance goals and falling short. On the battlefield, it can mean the difference between completing the mission and becoming a casualty.

NUTRIENTS

Soldiers need to have a basic understanding of the classes of nutrients and how different food choices impact performance and health. Food is more than just a hunger stopper. In order to perform work, the body needs a constant supply of energy. This energy comes from the food we eat in the form of calories (kcal). Food contains essential nutrients, which perform three basic roles in the body. Nutrients supply energy, promote growth and repair of body tissue, and regulate body processes. All nutrients fall into one of six categories shown in Figure 1.

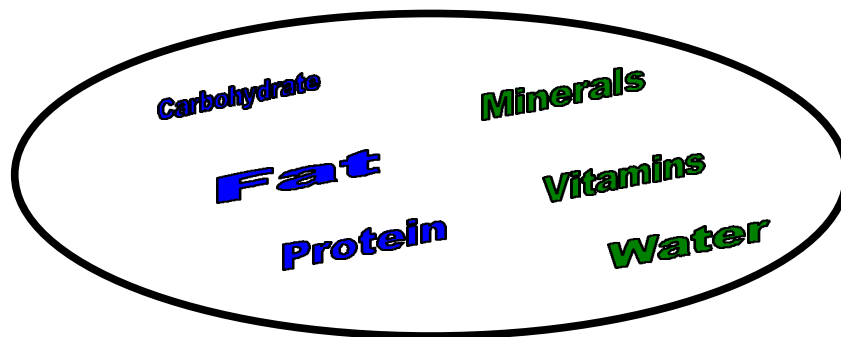


Figure 1, Nutrients

Carbohydrate, protein, and fat are called the energy providing nutrients. Carbohydrates are a source of calories from sugars and starches that fuel your muscles and brain. They are the body's primary energy source for high intensity activity. Protein from the fish, meat, poultry, tofu, and beans we eat is essential for building and repairing muscle tissue, red blood cells, hair

Nutrition for Performance

and other tissues, and for synthesizing hormones. It's also an energy source in the absence of carbohydrate. Fat is a source of energy that's burned mostly during low-level and long-term activity. Dietary fat comes from both saturated animal sources and unsaturated plant sources. Saturated fats like butter, animal fat, and shortening tend to increase the risk of heart disease and some cancers in most soldiers. The other three nutrients which do not supply energy but that are important to normal body functions are vitamins, minerals, and water. Vitamins are metabolic catalysts that regulate chemical reactions in the body. The body can't manufacture most of the required vitamins, so they must be obtained from a well-rounded diet. Minerals are elements that combine to play an essential role in the growth and repair of body structures and in the regulation of body processes. Water is perhaps the most important nutrient even though it doesn't directly provide energy, promote growth or repair of tissues, or regulate any processes. Water is the medium in which these three roles occur making up 60-75 % of a soldier's body weight. Without adequate amounts of water optimal function is not possible. Another reason for staying well hydrated is the effect that dehydration has on performance; as little as a two percent decrease in body weight (due to water loss) can significantly decrease performance.

PRINCIPLES OF NUTRITION

For the individual soldier, nutrition involves many choices on a daily basis. Soldiers who use the principles of nutrition (moderation, variety, natural selection) and the Food Guide Pyramid to make their daily food choices will be better prepared to perform at their best.

Moderation: Soldiers always want to know if a particular food is good or bad for them. No single food choice is necessarily a bad choice. Too many bad choices over time can accumulate into a poor diet. Poor choices like a lunch of soda, chips, and a greasy hamburger once in a while will be balanced out by a better choice like a turkey sandwich with low-fat dressing on whole wheat bread and fruit on a regular basis. Eating for performance and health doesn't mean that soldiers have to give up their favorite foods.

Variety: Unfortunately, there is no one perfect performance diet that can be applied to all soldiers and there is no single magic food. Different foods offer different specific nutrients. Choosing from a variety of foods will ensure that the body receives all of the nutrients it needs. The food pyramid is a good place to start when designing a performance diet. Food labels help guide choices when shopping for the right foods.

Natural Selection: Choose natural or less processed foods whenever possible. An apple is a better choice than applesauce, which is a better choice than apple juice. A baked potato is a better choice than mashed potatoes, which is a better choice than potato chips. Whole grain (wheat) bread is usually a better choice nutritionally than white bread. Food processing tends to remove vitamins, minerals, and fiber and add undesirable or questionable additives.

THE FOOD GUIDE PYRAMID

The Food Guide Pyramid, Figure 2 was developed by the U.S. Department of Agriculture and divides food into six groups that fit together into a pyramid. The bottom of the pyramid contains the bread, cereal, rice and pasta group which should form the foundation of a healthy

Nutrition for Performance

performance diet. Vegetables and fruits follow closely behind with the higher fat meat and dairy products holding the smaller spots near the top. The top of the pyramid contains the sugars, fats, and oils that soldiers tend to get enough of without even trying. Serving size is greatly misunderstood. A single serving can be estimated as the size of a deck of playing cards or a tennis ball. When making dietary choices it's important to know and keep in mind the serving size.

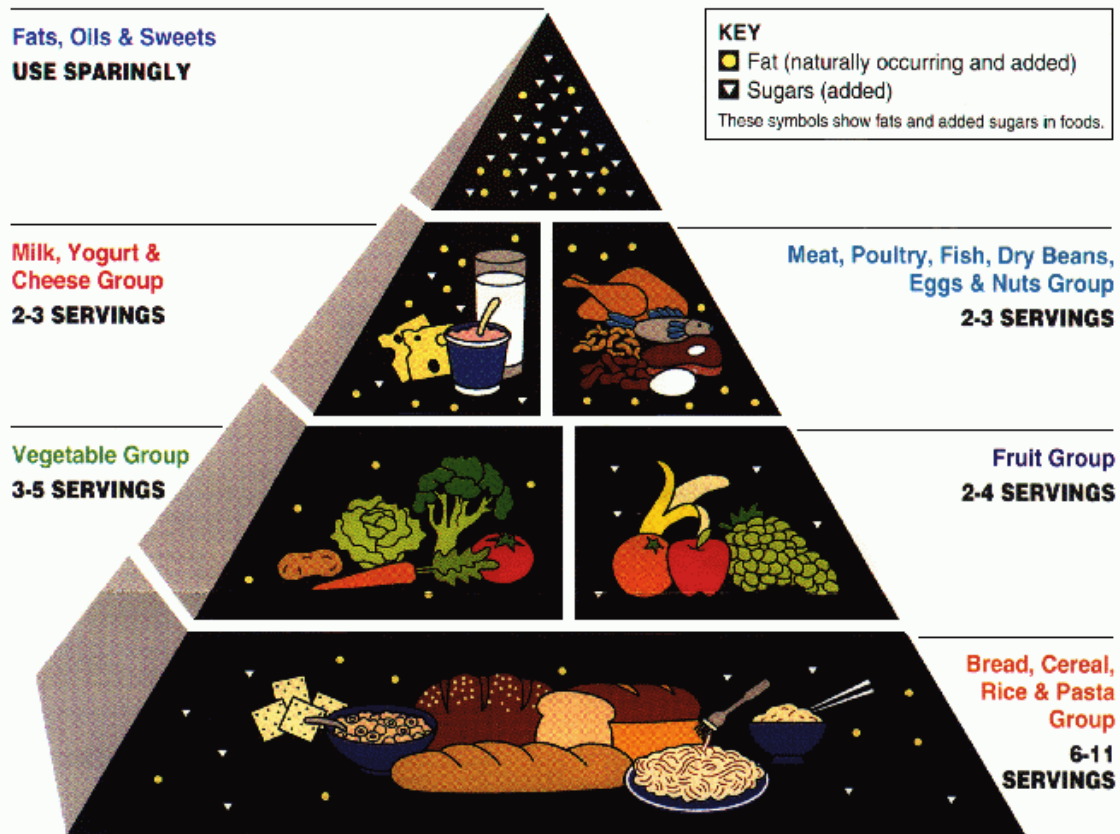


Figure 2, Food Guide Pyramid

FOOD GROUPS

Breads, Cereals, Rice, and Pasta Group: Most of the carbohydrates in a performance diet come from this group. Soldiers should consume at least 6-11 servings daily. Consuming the recommended daily intake is not difficult if you understand serving sizes. Refer to Figure 3 for serving sizes. The best choices from this food group are bran cereals, oat bran, low fat bagels (pumpernickel, rye, whole wheat), whole grain muffins (bran, corn and oat bran), whole grain breads and rice, and stoned wheat and whole grain crackers.

Vegetable Group: The vegetable group is one area where many soldiers usually fail to consume enough. Vegetables are nature's vitamins. This group is very important for ensuring that you get essential vitamins and minerals. Soldiers should strive for 3-5 servings per day. This is not

Nutrition for Performance

difficult to achieve after examining the serving sizes. A serving size of raw or cooked vegetables is only $\frac{1}{2}$ cup, and most people eat more. One cup of leafy raw vegetables is also a serving size, which is much smaller than the regular salad served with a restaurant dinner. To maximize the vitamin and mineral content of your vegetables, don't overcook. Cook in a microwave, steamer, or wok only until tender crisp. The lighter colored vegetables, such as cucumbers, iceberg lettuce, and celery are mostly just fiber and water with very little calories, vitamins, or minerals. Choose dark green, orange, yellow vegetables. The darker the vegetable, the more likely it is to have large amounts of vitamins and minerals. A variety of different vegetables should also be consumed to ensure that you receive a variety of nutrients. Broccoli, spinach, green peppers, tomatoes and sauce, cauliflower, Brussels sprouts, collards, carrots, or winter squash are the best choices. A $\frac{3}{4}$ cup of vegetable juice also constitutes a serving from this group.

Food Portion	Same Size As:
$\frac{1}{2}$ cup cooked rice, cereal, pasta	Fist
$\frac{1}{2}$ cup vegetables, fruit	Tennis ball
1 oz cheese cubed	4 dice
1 tbsp peanut butter	$\frac{1}{2}$ golf ball
1 oz cheese, grated	Ping-pong ball
2-3 oz meat, poultry, fish	Deck of cards

Figure 3, Estimating Food Guide Pyramid Serving Sizes

Fruit Group: The fruit group, in addition to providing vitamins, and minerals, provides fiber also aids recovery. Two to four servings of fruits are recommended each day. Breakfast is a good opportunity to eat fruit. Drinking a glass of fruit juice for breakfast is a convenient way to get half of the minimum daily servings. Other good choices are citrus fruits, bananas, cantaloupe, kiwi, strawberries, and dried fruit. A serving size for the fruit group is one piece of medium sized fruit or melon wedge, $\frac{1}{2}$ cup of chopped, canned, or cooked fruit. If you choose fruit juice, make sure that it is not mostly sugar and contains a good amount of vitamins and minerals. A $\frac{3}{4}$ cup of fruit juice equals one serving. Juice that you can see through (apple, grape, or cranberry juice) usually contains more processed sugar than one that you cannot see through (orange juice, peach nectar, or prune juice).

Milk, Yogurt, and Cheese Group: These dairy products are a great source of protein, vitamins, and minerals (fortified by law) especially calcium and riboflavin. The milk group, however, can also contain a large amount of fat. Many no-fat or low-fat dairy products are available, including cheese, milk, sour cream, and yogurt. Top choices are 1% or skim milk, low-fat cheese, and yogurt. The recommended number of servings per day for this group is 2-3, and is easily attainable for most soldiers. One cup of milk or yogurt, a $\frac{1}{2}$ cup of natural cheese (Cheddar or Swiss), or 2 ounces of processed cheese (American) is considered a serving size.

Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts Group: The Meat and Beans Group is very important for obtaining protein, vitamins, and minerals. Like the milk group, this group can contain large amounts of fat as well. Quick and easy choices include canned tuna, chicken, peanut butter, lentil soup, and beans. Two to three servings from this group are required each day. Most soldiers are at one extreme or the other by consuming too much or not enough from this group. The serving sizes typically consumed greatly exceed the nutritional requirement. For example, a typical chicken breast (8 oz) equals 2 servings (and about 50 grams of protein) while

Nutrition for Performance

the 16-ounce steak at your favorite restaurant equals 4 servings (and about 120 grams of protein) from this group. A serving size of cooked fish, poultry, or red meat is 2 to 3 ounces (the size of a regular deck of playing cards), a ½ cup of cooked dry beans, a 2 ½ ounce soyburger, 1 egg, 2 tablespoons of peanut butter, or 1/3 cup of nuts.

Fats, Oils, and Sweets Group: At the top of the food pyramid are the items that should be eaten in moderation. It does not mean that you should never eat these items. Most fats and sugars are nutrient poor. Foods from this group should be chosen sparingly because they often replace nutrient dense foods, so soldiers don't get their daily requirement for the essential nutrients. For this reason, they are referred to as "empty" calories. This means that they provide nothing to the body except calories; no vitamins, minerals, fiber, water, or protein. However, foods from this group are still an important part of a performance diet. Sweets add taste and flavor, while fat provides essential fatty acids like linoleic acid (part of every cell membrane), which can't be made by the body. A better food preparation choice is baking, roasting, or grilling, however, frying food in fat (cooking oil) once in a while is all right. The principle of moderation is important. Top choices from this group include olive oil, walnuts, molasses, berry jams, or a favorite dessert. There are no suggested servings for the top of the pyramid because soldiers have plenty of opportunity to add these to their diet without even trying.

NUTRITION ASSESSMENT

The first step in developing a sound PRT program is to conduct an assessment. The same is true for developing a performance diet. Soldiers need an idea of their current habits and nutrient intake before they can determine the changes that will improve their choices. A simple diet assessment is called a diet recall. The steps for conducting a diet recall are as follows:

1. Write down everything they eat and the portion consumed in a food log as shown in Figure 4 for 3-7 days.
2. Record the number of carbohydrate, fat, protein, and fiber grams in the foods from the food label, food composition book, or Internet sources.
3. Add total calories from carbohydrate (4 calories per gram), fat (9 calories per gram), and protein (4 calories per gram) and determine the percentage of diet that came from carbohydrate, fat, and protein. For example, if a soldier consumed an average of 2100 calories per day of which an average of 275 grams per day were from carbohydrate sources, then $275 \text{ g} \times 4 \text{ cal/g} = 1100 \text{ calories}$. $1100 / 2100 \text{ calories} \times 100\% = 52\%$ of calories from carbohydrate.
4. Assess whether diet is consistent with this appendix and determine the changes that can be made for improvement. For example, 53% carbohydrates from step 3 above is below the daily recommendation, so the action for improvement is to choose more carbohydrates at meal and snack time. It's better to make smaller changes gradually.

Nutrition for Performance

Food, Amount	Carb. (g)	Fat (g)	Protein (g)	Fiber (g)
Eggs, hardboiled, 2	2	12	12	0
Bacon, 3 med strips	0	9	6	0
Toast, whole wheat, 2 slices	26	2	6	4
Margarine, soft, 2 tbsp.	0	11	0	0
Orange juice, 8 oz.	25	0	1	1
Total (g)	53	34	24	5
Total (cal)	212	306	96	-

Figure 4, Sample Food Log (breakfast)

FOOD LABELS

Grocery store aisles are avenues to greater nutritional knowledge. The food label is the next step to better food choices. At first glance, all the numbers and percentages on a food label may look intimidating. As soldiers become more familiar with its format, they will see how the label can help compare products for nutritional quality. Food labels have several parts including the front panel, Nutrition Facts, and ingredient list. The front panel often tells if nutrients have been added, for example, iodized salt (iodine) or enriched pasta (thiamin, riboflavin, niacin, iron, and folic acid). The ingredient list tells you what's in the food including any nutrients, fats, or sugars that have been added. The ingredients are listed in descending order by weight. Let's take a closer look at the Nutrition Facts. Food companies must list, at a minimum, the amount of calories, calories from fat, total fat, saturated fat, cholesterol, sodium, total carbohydrate, dietary fiber, sugars, protein, vitamins A and C, calcium and iron that are contained in their product. Experts believe too much or too little of these 12 nutrients will have the greatest impact on your health and performance. Some of the things you might want to examine more closely include:

Serving size: Located at the top of the label, this information is based on consistent serving sizes that are reflective of the amounts most people eat. This makes it easier for you to compare the nutritional value of two different peanut butters, for example. The label tells you how much of certain nutrients are in each serving. Most products contain several servings. The serving sizes may be different from your usual serving and different from those used in the Food Guide Pyramid. For instance, 2 ounces of dry macaroni yields about 1 cup cooked, or two (1/2 cup) food pyramid servings.

Calories and Calories from Fat: The next line from the top lists total calories per serving. Remember that if you eat the whole box of macaroni & cheese (2 servings) you will be consuming double the amount of calories listed on the label (250 calories per serving x 2 servings = 500 calories). On the same line, calories from fat is listed. This corresponds to the total fat listed on the next line (12 g total fat x 9 fat calories per g = 108 rounded to 110 calories from fat). You can also use this information to determine the percentage of the product that is fat (110 calories from fat / 250 total calories = 0.43 x 100% = 43% fat). Almost half of this product is fat no matter how many servings you eat.

Nutrition for Performance

Fat: Next, the Nutrition Facts lists the total fat in grams as well as the number of grams of the total fat that is from saturated fat. The remaining fat grams (9 grams) are from unsaturated sources.

Carbohydrates: Total carbohydrate grams are listed as well as carbohydrates from dietary fiber and sugar. In our example, the product contains 31 g of total carbohydrate, no fiber, and 5 grams of sugar.

Protein: Remember to look at grams from Protein to make sure you are consuming an adequate amount every day.

Percent Daily Value: To the right of the list of nutrients is a list of percentages. These numbers tell you the percent of the daily value (the amount of that nutrient you should eat a day, based on a 2,000-calorie diet) that one serving of the product will give you. For example, the label can tell you that 12 grams of fat is 18% of the daily value that the average consumer should have. Knowing that one food provides as much as 18% of your daily total may make it easier for you to plan the rest of your diet for that day. However, the footnote at the bottom of the label reminds you that the Percent Daily Value is based on a 2,000-calorie diet. Most soldiers will need to consume more or less than 2000 calories for optimal performance.

Lastly, there may be a note stating that there are 9 calories per gram of fat and 4 calories each per gram of carbohydrates and proteins. This is a standard measurement. Notice that fat provides more than twice the energy per gram.

Some foods with only a few nutrients or small space for a label may have an abbreviated or smaller label. Many of the foods that fit into a performance diet don't have labels. Labeling for fresh produce, fish, poultry, and meats is voluntary. Grocery stores will often have nutrient information available, however. Dining facilities and most fast food restaurants also have nutrient information available for their foods. It may be posted or you may have to ask for it.

THE ENERGY NUTRIENTS

Carbohydrate

To increase and maintain strength, endurance, and mobility, soldiers must consume adequate amounts of carbohydrate, protein, and, fat. Carbohydrate is the body's predominant fuel for muscles during all activity and is the least abundant nutrient stored in the body (fat is the most abundant). Carbohydrate is stored in the liver and muscles as glycogen, and circulates in the blood as glucose (blood sugar); however, these stores are limited (about 1800 calories for a

Macaroni & Cheese

Nutrition Facts	
Serving Size 1 cup (228g)	
Serving Per Container 2	
Amount Per Serving	
Calories 250	Calories from Fat 110
% Daily Value*	
Total Fat 12g	18%
Saturated Fat 3g	15%
Cholesterol 30mg	10%
Sodium 470mg	20%
Total Carbohydrate 31g	10%
Dietary Fiber 0g	0%
Sugars 5g	
Protein 5g	
Vitamin A	4%
Vitamin C	2%
Calcium	20%
Iron	4%
* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:	
	Calories: 2,000 2,500
Total Fat	Less than 65g 80g
Sat Fat	Less than 20g 25g
Cholesterol	Less than 300mg 300mg
Sodium	Less than 2,400mg 2,400mg
Total Carbohydrate	300g 375g
Dietary Fiber	25g 30g

Nutrition for Performance

trained 150 lb athlete). Two hours of continuous activity or eight hours of fasting significantly depletes these stores, and it can take 24 to 48 hours to fully replenish them. Soldiers who habitually eat a high-carbohydrate diet replenish muscle glycogen stores daily, which, in turn, allows them to continue to perform at high levels of intensity. Eating a low carbohydrate diet does not allow the body to recover to its preactivity glycogen level before the next bout of activity. Soldiers will not have the energy needed to train at a high level. [One adaptation of regular, precise PRT is that the body will recognize a need for an increased amount of glycogen storage.] Adequate daily intake of carbohydrate will help to achieve the two things soldiers want most: build and/or preserve muscle and burn more body fat. When the body's carbohydrate stores are depleted during reduced intake and/or strenuous activity, the body turns to itself for energy, breaking down muscle (protein). Adequate carbohydrate intake helps to spare protein, allowing proteins (amino acids) to carry out the function of preserving lean body mass. When a soldier runs out of carbohydrate from stored glycogen or an inadequate diet, the body releases amino acids from muscle tissue for use as energy. This catabolism (breakdown) of protein also occurs during intense workouts (in particular prolonged endurance activities like running or cycling). When the body uses amino acids as energy, they are diverted from their primary role of building muscle and their other metabolic functions. So a daily diet high in carbohydrate will spare protein, and the subsequent loss of muscle as activity level increases. Carbohydrates are also required for efficient fat metabolism. Carbohydrate is the primer for fat burning, so if carbohydrate stores are low, fat cannot efficiently be used as the primary energy source for muscles. A good way to remember this is the expression "Fat burns in the flame of carbohydrate." Many carbohydrate sources are also high in fiber which helps the body's digestive process run smoothly. Fiber is a complex carbohydrate that doesn't provide energy and can't be digested but is important nonetheless. An adequate daily intake of fiber can make you feel fuller on fewer calories, prevent constipation, and reduce the risk of some cancers. Soldiers should strive for 20-35 grams of fiber per day by choosing foods higher in fiber such as whole grains (whole wheat bread), fruits, vegetables, legumes (beans and peas), and bran cereal and muffins. For the reasons stated above, for optimal performance soldiers should consume 50-60% of their daily calories from carbohydrate sources (carbohydrate provides four calories per gram of food). This is approximately equal to 3-4 grams/pound of body weight per day.

Protein

Protein is not the body's preferred source of energy during exercise and is generally only used when glucose and/or fatty acids are not available. Proteins are composed of different amino acids, which are crucial to the building and repairing of body tissue. An adequate supply of protein is essential to the building (and maintenance) of new muscle tissue. However, more protein by itself will not build muscle. Soldiers must consume an adequate amount of protein and perform quality PRT on a regular basis to increase strength, speed, and size. Soldiers training to increase strength, size, and speed may also need to take in more carbohydrates (200-500 calories per day) to provide the extra energy needed to train at their best. A diet that is too low in protein, like carbohydrate, can also cause fatigue and lead to poor performance. Soldiers, who train hard, usually need more protein than the average sedentary individual. Several factors determine the amount of protein needed, such as intensity and duration of activity, degree of training, and body weight. The U.S. Recommended Daily Allowance (RDA) for protein is 0.8 grams/kilogram of body weight, which is about 0.4 grams per pound of body weight. This is the

Nutrition for Performance

minimum daily requirement for the average American. The daily protein requirement for active soldiers is usually higher, representing an intake equivalent to 0.75-1.0 grams per pound of body weight. Less active soldiers should be at the low end (0.75 grams per pound) of the range while soldiers who perform intense strength and endurance training regularly (in addition to routine PRT) should be closer to 1.0 gram per pound. Figure 5 lists more specific guidance on adequate daily protein intake for soldiers. As protein consumption increases, water intake must also increase. Refer to the section on water for fluid intake guidance. Soldiers should strive for adequate amounts of protein in their diet, not excessive amounts. As stated before, more is not always better. Sitting around drinking protein shakes is more likely to lead to extra fat not muscle. Consuming protein in excess of the amount needed for tissue growth and repair can be a problem. High protein (and low carbohydrate) diets are not appropriate for soldiers who are attempting to perform at their best. Unlike carbohydrate and fat, protein cannot be stored. Protein that is not used or excreted by the body will be converted to fat and stored as body fat. Many protein choices soldiers make are also high in saturated fat and cholesterol and low in fiber and other nutrients. Figure 6 shows some of the top food choices for ensuring an adequate intake of protein. Food sources are the usually the most effective, and least costly way to meet daily protein requirements. Protein powders and bars can be a convenient and easy way to supplement food sources so that daily protein requirements are met. A protein shake with low fat milk and fruit is an easy way to add a nutritious protein and carbohydrate snack to the diet. Soldiers should know their protein requirements, and how much they derive from food sources, before turning to supplements to meet daily requirements.

Daily Protein Requirements for Soldiers	
Activity Level	Protein (grams per lb of body weight)
Sedentary	0.4
Routine PRT (< 90 minutes), 3-5 times per week	0.5-0.7
Routine PRT PLUS additional endurance training 3-5 times per week "runners"	0.7-0.8
Routine PRT PLUS additional resistance training 3-5 times per week "weight lifters"	0.8-0.9
PRT PLUS additional endurance (> 90 minutes) AND resistance training 4-6 times per week "triathletes"	1.0

Figure 5, Protein Requirements for Soldiers

Food	Serving	Protein (g)	Fat (g)
Turkey	3 oz	26	1
Chicken (skinless)	3 oz	24	2
Lean beef	4 oz	22	8
Fish	3 oz	20	5
Peanut butter	2 tbsp	10	16
Tofu (soybean curd)	3 oz	9	5
Beans	½ cup	7	1

Figure 6, Top Protein Choices

Nutrition for Performance

Fat

Fat performs vital functions in the body such as the protection of organs and transportation of the fat-soluble vitamins A, D, E, and K. Fat is not a primary source of energy for high intensity work since energy released from fat metabolism occurs at a much slower rate (requires oxygen) than energy released from carbohydrate metabolism. It is an efficient source of calories, supplying nine calories per gram, more than double that of protein and carbohydrate. Fat is the body's primary energy source for low intensity activity. All soldiers have an enormous amount of potential energy stored as fat in their bodies. A 185-pound male with 15% body fat carries 28 pounds of fat, enough to run over 45 marathons. As stated before, carbohydrate is needed to start fat burning. When the body's carbohydrate tanks are empty, fat burning cannot continue efficiently and soldiers are forced to decrease their pace (slow down). [One of the body's adaptations to regular, precise PRT is that it will burn more body fat sooner]. Fat requirements for energy and essential fatty acid can be met when fat composes 20-25% or less of a soldier's total daily caloric intake. Since fat has a high caloric density (9 calories per gram) and tastes good, it can be easy to over consume which will lead to weight gain. Fat and carbohydrate tend to have a reciprocal relationship in the diet (as fat intake increases, carbohydrate intake decreases), which can impair performance. Soldiers attempting to reduce their body fat can most easily reduce their overall caloric intake by consuming less fat. Reduce fat intake by making the following choices:

- lower fat carbohydrates
- lean meat, fish, poultry, beans and peas as protein sources
- Trim excess fat off meats before cooking
- Bake, broil, or boil rather than frying
- Read food labels for hidden fat and compare food items before buying.

All fats contain about 120 calories per tablespoon but the best choices are from heart healthy sources. Heart healthy fats are unsaturated (poly- and mono-) fats that are typically liquids at room temperature and do not raise blood cholesterol levels. Examples include vegetable oils (corn, olive, canola, peanut, and sunflower), nuts, olives, avocados, and salmon. Saturated fats from solid margarines and butters, milk, cheese, ice cream, animal beef, poultry, and tropical and solid oil and shortening (Crisco, coconut, palm, lard) should be consumed in moderation because it has been linked to increased risk of disease. Consuming less saturated fat will have the added benefit of corresponding to fewer overall calories from fat. Trans fats (unsaturated fats that are saturated for stability) are found in partially hydrogenated vegetable shortening, hard margarines, and commercial fried foods and baked goods and should be consumed in moderation. Eating cold-water fish (salmon, tuna), nuts, and olive oil, which contain Omega-3 fatty acid, at least once a week may decrease a soldier's risk of disease.

Water

Although it provides no calories, water is the most important nutrient in the body. Everything that happens in the body occurs in the medium of water. Water carries nutrients and wastes to and from cells, helps regulate body temperature, and prevents dehydration. Most soldiers don't drink enough water and are in a chronic state of dehydration. Even mild dehydration (indicated by a loss of 2 % body weight) affects a soldier's physical performance, mood, and the desire to

Nutrition for Performance

eat. More severe dehydration increases the risk of heat injury or illness. The recommended daily allowance for water is 64 ounces. However, this is not enough for active soldiers. Soldiers should drink at least 96-128 ounces of water a day. It's better to drink small amounts of water frequently than to drink large amounts occasionally. Soldiers should carry a water bottle or canteen to develop the habit of drinking water constantly throughout the day. Thirst is not a reliable indicator of fluid need. Soldiers that have to go to the bathroom frequently (every 2 hours or less) and have lighter (pale yellow) urine are probably drinking enough water. An infrequent trip to the bathroom with dark, concentrated urine is an indication of a low fluid level. Plain, cold (refrigerator temperature, approximately 40 degrees F) water is the best beverage for maintaining adequate hydration since the stomach easily empties it and absorbs it quickly into the rest of the body. Almost any type of food or beverage with high water content helps soldiers meet their water requirement (i.e. Kool-Aid, juice, decaffeinated coffee, tea, soft drinks, lemonade, soups, milk, fruits, vegetables). However, keep in mind that some of these beverages also contain "empty" calories that may or may not be desired. Drinking alcoholic or caffeinated beverages may increase urination and the tendency for dehydration. Drinks that contain caffeine (coffee, soda, tea, etc.) promote fluid loss from the body. If soldiers drink caffeinated beverages, they should drink extra amounts to replace water lost in urine.

Sport Drinks

Plain old water will always be the best "sports drink" for soldiers who exercise for less than 60-90 minutes at a time. Water is readily available, inexpensive, settles well, and replaces sweat losses. Commercial sports drinks are available that consist mainly of simple sugars, water, and electrolytes (sodium, potassium). They may aid performance during intense endurance activities lasting 90 minutes or longer by increasing mental and physical stamina. For events lasting less than 90 minutes, sports drinks are not necessary for a soldier who regularly consumes an adequate daily dose of carbohydrates. However, because of the taste, soldiers may be more likely to consume sport drinks than water. Soldiers can make their own sports drinks by adding a splash of fruit juice or lemon. For more information on sports drinks refer to Nourishment During PRT Activities.

NUTRITION BEFORE PRT ACTIVITIES

Soldiers need to consume a high carbohydrate diet from a variety of sources for maximum performance. But it's not enough to just say, "Eat a lot of carbohydrates." Soldiers must consider the type of carbohydrate, timing of consumption, as well as protein, and fluid intake. Adequate food consumption before training will prevent low blood sugar and fatigue, curb hunger, fuel the muscles, and pacify the mind. There is no one magic recipe or meal. Food preferences will vary depending on the type of activity, intensity, and time of day. For some soldiers food will be more psychological than physiological. Since most unit PRT sessions last less than 90 minutes, the foods a soldier eats on a regular basis is more important than what they eat in preparation for a routine training session. Food eaten within an hour of a PRT session doesn't provide muscle fuel; it just keeps you from feeling hungry. A high carbohydrate diet with adequate protein and fat day in and day out will provide all the energy soldiers need for daily PRT sessions. Furthermore, it may not be practical or possible for soldiers to eat a meal before an early morning PRT session. A one-day high carbohydrate diet will adequately fuel

Nutrition for Performance

muscles for a morning PRT session. However, if soldiers go from dinner until an early morning workout without eating they may feel hungry and sluggish and consequently not perform their best. Soldiers, who perform PRT first thing in the morning, should experiment with evening vs. morning snacking to determine what works best for them. Soldiers who perform PRT at the middle or end of the workday must be concerned about pre-activity nourishment. Pre-activity foods should be eaten long enough before the session to allow time for digestion (at least 1-2 hours for liquids and small snacks to 3-4 hours for large meals). As the intensity and especially duration of an activity increases, it becomes even important to eat the right type and adequate quantity of food at the right time. This mainly applies to non-stop activities of greater than 90 minutes such as a 20-kilometer foot march. For these activities or events, soldiers should eat about 0.5 grams per lb of body weight of low glycemic index carbohydrate, 1-2 hours before the activity. The glycemic index (GI) is a ranking of foods based on their immediate effect on blood sugar levels. The rate at which glucose enters the bloodstream affects insulin response to food and ultimately affects the fuel available to the exercising muscles. Many soldiers (and coaches and their athletes) still think that sugars are the best source for quick energy and that starches are best for sustained energy. Starchy carbohydrates (pasta, rice, cereals, potatoes) are not necessarily digested slowly as traditionally thought based on chemical structure, while all simple carbohydrates (sugars) are not necessarily digested quickly with a corresponding rapid increase in blood sugar levels. Research has shown that low GI foods eaten alone 1-2 hours before an activity can prolong endurance. Figure 7 lists some examples of commonly eaten carbohydrates and their associated glycemic index.

LOW GI (<55) – Eat Before Activity		HIGH GI (>70) – Eat During and After Activity	
Food	GI	Food	GI
Soy beans	18	Lifesavers	70
Grapefruit	25	Bread, white	70
Kidney beans	27	Skittles fruit chews	70
Milk, whole	27	English muffins	70
Milk, skim	32	Rice, white, short grain	72
Lima beans	32	Watermelon	72
Fruit yogurt, low fat	33	Bagel, white	72
Chocolate milk	34	Honey	73
Spaghetti cooked	37	Sports Drinks	73-78
Apple	38	Cheerios	74
Pear	38	Graham crackers	74
Apple juice (unsweetened)	40	Vanilla wafers	77
Bread, pumpernickel	41	Jelly beans	80
Peach	42	Rice cakes	82
Lentil soup	43	Rice Krispies	82
Orange	44	Pretzels	83
Orange juice	46	Kellogg's Corn flakes	84
Grapes	46	Potato, baked	85
Baked beans	48		
Peas	48		
Bulgur	48		
Oatmeal (old fashioned)	49		
Kellogg's All-Bran with fiber	51		

Figure 7, Glycemic Index

Nutrition for Performance

NUTRITION DURING PRT ACTIVITIES

Unlike the fat stores in the body that can release almost unlimited supplies of fatty acids, carbohydrate stores will be completely depleted by 2-3 hours of hard activity. This emptying of the tank is often called “hitting the wall” or “bonking”. If activity continues at the same pace, blood sugar concentration declines to a point that interferes with brain function and causes disorientation and even unconsciousness. As stated before, a regular high carbohydrate diet will provide all the energy necessary for routine daily PRT sessions. During continuous long duration events (greater than 90 minutes), carbohydrate should be replaced with high GI foods at a rate of 30 to 60 grams per hour. Liquids are usually tolerated better than solid foods and they empty faster from the stomach to be available to the working muscles sooner. Commercial fluid replacement drinks (GI of 73-78) can be a good choice. Sports drinks serve a dual function in nutrient replacement during exercise. They aid in the replacement of water lost in sweat as well as carbohydrates used by the working muscles. When muscle glycogen stores decrease during moderate to hard activity, the body relies more on blood glucose for energy. Adding carbohydrate during a workout can help maintain normal blood sugar levels allowing longer activity. The best choice is usually a sports drink that contains 40-80 calories per 8 ounces (a 4-8% carbohydrate solution) and 120-170 mg of sodium. This weak carbohydrate solution empties from the stomach faster than solid food and is preferred to juice (which contains 100% carbohydrate) that will stay in the stomach longer so less goes to the peripheral organs and muscles. Fruit juices and soft drinks can also cause abdominal cramps, nausea, and diarrhea in some individuals.

NOURISHMENT AFTER PRT ACTIVITIES

Many soldiers make the mistake of not eating for several hours after PRT. The food soldiers eat (or don't eat) after a hard workout will have the most affect on recovery and subsequent performance. Soldiers can maximize recovery by consuming a carbohydrate and protein mixture within 30 minutes of completing intense activity. Research shows that muscles are most sensitive to glucose in the bloodstream right after exercise, so soldiers should eat at least 0.5 grams of high glycemic carbohydrate as soon as possible after PRT. Research subjects who waited over 2 hours before refueling were only able to restore half as much muscle glycogen. Some protein can also enhance glycogen replacement right after exercise and provide amino acids to aid in the body's repair process after hard exercise. The best carbohydrate to protein recovery ratio seems to be 4 to 1 (1 gram of protein for every 4 grams of carbohydrate). A 150-pound soldier should consume 75 g (300 calories) of high GI carbohydrate (low-fat) and 18 grams (72 calories) of protein (low-fat). More protein during recovery is not necessarily better. Too much protein (like fat) during recovery tends to slow re-hydration and consequently glycogen replenishment. Ensuring that soldiers have food on hand at the right time requires a little planning and effort. A carbohydrate/protein shake (powder plus water) is a convenient recovery option that also empties from the stomach faster than solid food, is better tolerated than solid food after exercise, and also helps aids re-hydration. An example of an excellent recovery food for a soldier might be a plain bagel (GI=72) and a few slices of turkey and/or low fat cheese (low fat protein source). Sports drinks intended to be taken during a workout are also convenient after, though, not necessarily the best choice by themselves. They contain less than 10% carbohydrate when your muscles are craving full strength carbohydrates and they lack the

Nutrition for Performance

vitamins and minerals in nutrient dense whole foods. And for the average soldier, electrolyte losses in sweat during PRT are not a major concern. Electrolyte concentration is important because they facilitate nerve impulses for muscle contraction and regulate fluid balance inside and outside of the cells. They can easily be replaced from the foods and fluids consumed during recovery. A wholesome diet from a variety of foods will ensure that soldiers are getting enough electrolytes to replace any lost during exercise. A soldier's recovery diet becomes more important as frequency, intensity and duration of activity increase, but the bottom line is that soldiers should eat something as soon after PRT as possible to always be fueled up for future performance. Soldiers will enhance recovery by eating low-fat carbohydrate and protein snacks while working. Figure 8 shows some of the best snack choices. Rest is also an important aspect of recovery often overlooked by soldiers and commanders. Rest doesn't necessarily mean a lack of activity. Adequate sleep and adherence to the sample schedules in this manual will ensure that soldiers are prepared to train at a high intensity with minimal risk of injury.

Snack	Best Choices
Dry cereal	Chex, Shredded Miniwheats, Cheerios, corn bran, oat squares; add fruit, raisons, or cinnamon
Popcorn	Plain or add low-calorie butter flavor spray
Pretzels	Reduced salt
Crackers	Stoned wheat, sesame, bran, and other reduced or no-fat products
Muffins	Low-fat, whole bran or corn
Bagels	Whole grain
Fruits	Any fresh fruit
Yogurt	Low-fat or fat-free; flavor with cinnamon, vanilla, applesauce, and/or add protein powder
Sports bars, low-fat breakfast bars and low-fat granola bars	Pre-wrapped and portable
Nuts and seeds	Peanuts, pistachios, almonds, sunflowers, pumpkin
Potatoes	Microwave for recovery meal; Sweet potato adds nutrients

Figure 8, Best Snack Choices

SUPPLEMENTS

Food supplementation is a multimillion-dollar business. There are thousands of supplements on the market, most of which are easily accessible to soldiers. Supplements were traditionally defined as any product made of one or more of the essential nutrients such as vitamins or protein. That definition has to been broadened to include any product intended for ingestion as a supplement to the diet. Supplements include vitamins, minerals, herbs, amino acids, botanicals, as well as concentrates, metabolites, constituents, and extracts of these substances. Supplement product labels must include the words "dietary supplement". Most products that meet this definition are not strictly regulated and are therefore not subject to any tight standards on makeup or claims. Soldier's primary goal should be to always strive to obtain the nutrients they

Nutrition for Performance

need from the foods in their diet. Eating a variety of foods on a regular basis is the most important step toward this goal. Supplement powders and bars can be a convenient and portable method for busy soldiers to ensure they are consuming adequate supplies of the essential nutrients. Variety is still important because bars and powders are not always low fat, inexpensive, or easily digested by all. Supplementation should be part of a larger plan for an optimal performance diet not a replacement for poor habits and choices. Nor are supplements a substitute for regular, precise PRT. There is no one magic pill or powder that soldiers can take that will make them stronger, skinnier, or give them more energy. Soldiers considering supplements must weight the purported benefits against the potential risks (and cost) before deciding to use any product. Information is key. If a product makes claims that sound too good to be true, the claims probably are too good to be true.

Vitamins and Minerals

Vitamins are metabolic catalysts that regulate biochemical reactions in the body. The body cannot manufacture them so they must be obtained through the diet. There are thirteen known essential vitamins all with a specific function. Vitamins do not directly provide energy, enhance performance, or offer a competitive edge. The body needs the right amount of each; too much which can be harmful. Dieticians and nutritionists say that you can get all that you need from the foods that you eat. This should be your primary choice. However if you choose to take a supplement for insurance and piece of mind, choose a single one a day multi-vitamin that has passed a 45 minute dissolution test that offers close to 100% of the recommended daily allowance. Figure 9 lists a breakdown of the vitamins, their RDI, and function. Minerals are present in all living cells. They occur in nature and are passed through the food chain. Like vitamins, each has a unique role in the body. The major minerals needed are calcium, phosphorous, and magnesium. The trace minerals are iron, zinc, iodine, copper, manganese, fluoride, chromium, potassium, selenium, and molybdenum. Electrolytes are sodium, potassium, and chloride. Soldiers should be able to obtain all from a variety of wholesome foods with the possible exception of iron and zinc especially if on a no meat diet.

SUMMARY

- Soldiers that know the facts about proper nutrition have the knowledge to prevent injury or illness, to maximize their performance, and to ensure completion of the mission.
- Think of your training plate as having three sections. Over half should be filled with quality carbohydrate choices. The remaining third should be split between quality fat and protein choices. Each 5-6 smaller meals (and/or snacks) throughout the day.
- Listen to your body and note how you feel and perform with diet changes. Eat foods that are tried and tested before important activities. Experiment with gradual changes to find what works best for you.
- Eating for performance can be broken into a three-part process: pre-training nourishment, nourishment during training (if necessary), and post-training nourishment. However, for most soldiers, it's more important to make good choices on a regular basis then to focus on specific activity nourishment.
- The search for the ultimate performance diet will continue. Since nutritional advice can come from other soldiers, supplement salespersons, successful athletes, self-proclaimed nutrition experts, and trained nutrition specialists, soldiers should seek professional

Nutrition for Performance

advice from their installation registered dietician or a physician before making drastic changes to their diet.

Vitamin	Recommended Daily Intake	Functions
A (retinol)	5000 IU	Healthy eyes, skin, and lining of digestive and urinary tracts, and the nose
B1 (thiamin)	1.5 mg	Helps transform carbohydrates into energy
B2 (riboflavin)	1.7 mg	Energy release and healthy skin, mucous membranes, and nervous system
B3 (niacin)	20 mg	Helps transform food into energy, growth and production of hormones
B6 (pyridoxin, pyridoxamine)	2.0 mg	Synthesis and breakdown of amino acids, aids in metabolism
Folic acid	0.4 mg	Production of blood cells and healthy nervous system
Biotin	0.3 mg	Metabolism of carbohydrates, fats, and proteins
Panthenic acid	10 mg	Metabolism of carbohydrates, fats, and proteins
B12	6.0 mcg	Synthesis of red and white blood cells and for metabolism of food
C (ascorbic acid)	60 mg	Healthy connective tissue, bones, teeth, and cartilage, enhances immune function
D (cholecalciferol)	400 IU	Calcium and phosphorus metabolism and healthy bones and teeth
E (tocopherol)	30 IU	Nourishes and strengthens cells
K	70 to 140 mcg	Blood clotting

Figure 9, Vitamin Breakdown